The Acquisition Community Modeling & Simulation Strategy (AMSS)

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Agenda

- **Acquisition Modeling & Simulation – the Call for Action**
- **AMSS – Why was it conceived and How was it created**
- **Systems Modeling Use in Acquisition - Vision and Possibilities**
- **Systems Modeling Use in Acquisition – Supporting the Future**

AMSS – Acquisition Modeling & Simulation Strategy

Observations: Call for Action

- **Modeling and Simulation is not consistently applied in the acquisition lifecycle**
  - It is not consistently recognized as a component or enabler of Systems Engineering
  - It is not consistently productive for the program management team
  - It is inconsistently applied in phases of the acquisition lifecycle
- **Models and simulations are never used as a continuum of tools, or as a supplier of rationale and justification for analysis, evaluations, and assessments across the acquisition lifecycle**
  - It is not consistently represented in Service and component organizations
  - It is not, as a community, organized to answer questions, fill SE gaps, or share best practices
- **Modeling and simulation has a long-standing strategy for the general use, but it does not have a current roadmap for improvement in application (especially for acquisition)**
  - Acquisition modeling and simulation needs, capabilities, messages from PEO, PM not reaching OSD; and vice versa
- **"What do you need to model? How much fidelity do you need in that modeling? Is the modeling credible for use?"**

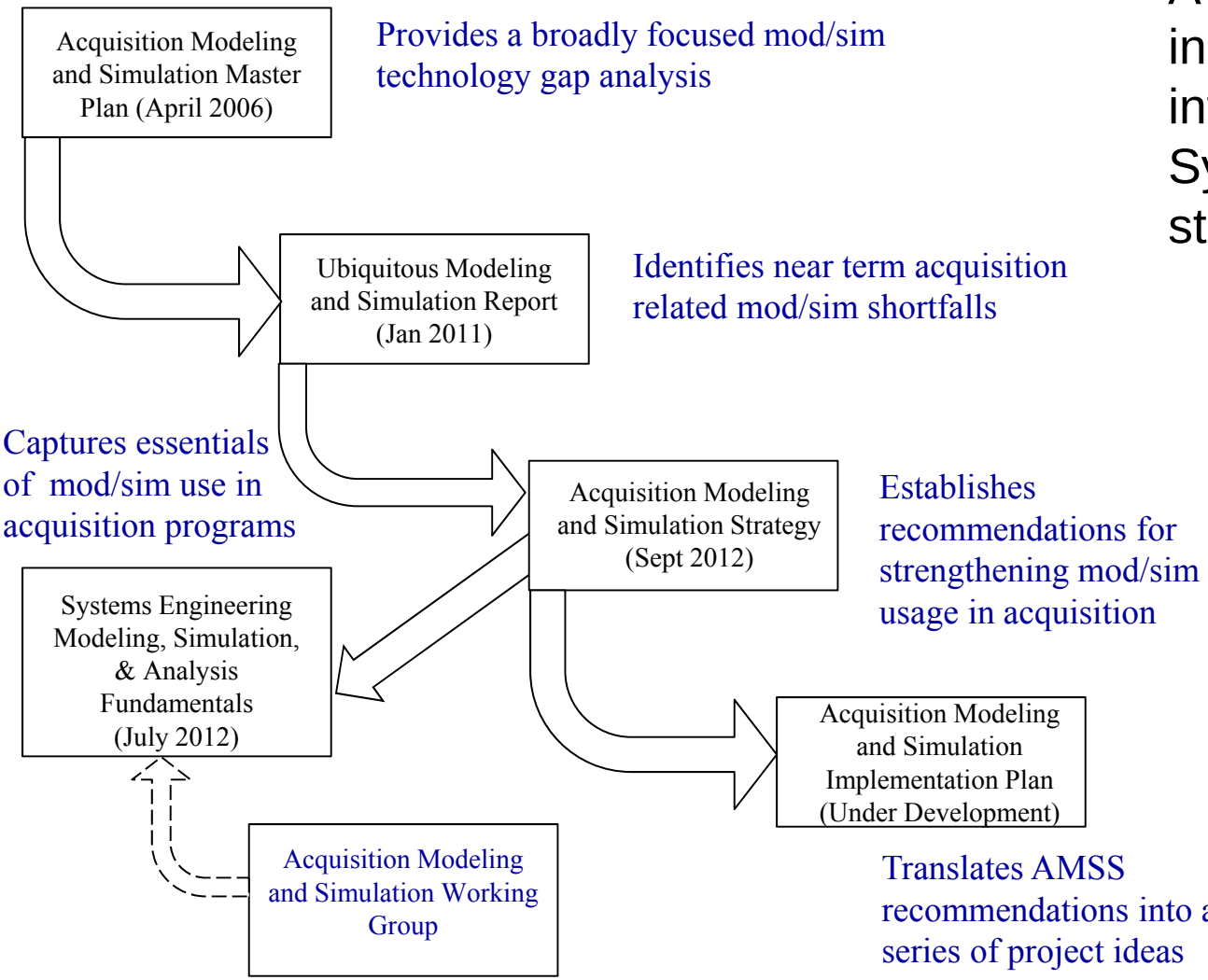
Purpose of the AMSS

The purpose of the Acquisition Community Modeling & Simulation Strategy is to synthesize the findings of recent research into the application of modeling & simulation in support of the acquisition system life cycle technical activities and recommend a near-term set of activities or investments that will move the Department of Defense forward towards improved use of systems modeling in acquisition.

Development Guidance for the AMSS

- **Identify high-priority opportunities focused on improving modeling & simulation's usefulness to program managers**
- **Concentrate on improving the confidence and usefulness of modeling and simulation In programs**
- **Focus on opportunities that can be executed within the next 2 to 4 years**
- **Ensure that projects have "leave-behind capability" or identify potential areas for further inquiry**
- **Support the Modeling and Simulation Coordination (M&SCO) office in developing modeling and simulation enterprise needs and capabilities**

How AMSS Was Conceived & Created
From Strategy to Execution



A number of other independent efforts also influenced the overall Systems Modeling strategy. :

- National Defense Industry Association (NDIA) study on Model Based Engineering (MBE)
- Rapid Capability Fielding "Toolbox" Study (Study sponsor: DDR&E)
- Various SBA studies from the late 1990s

Acquisition Modeling and Simulation Strategy

The AMSS is NOT a grand vision document, it is focused on critical 'next step' enablers to improve mod/sim effectiveness for acquisition functions & phases

- Identifies key near-term recommendations for research & innovation with primary focus on support to PM & Chief Engineers
- Heavy focus on viability vice policy
- Derived from recent sponsored research/studies on existing capabilities and needs
- Shaped with AMSWG and community collaboration
- Advocates increased emphasis on concurrent and integrated modeling between requirements, cost, schedule, performance, risk
- Next Steps:
  - convert appropriate AMSS recommendations into a set of (proposed) project definitions
  - a 10 Page (or less) companion: AMSS Executive Overview

AMSS
Recommendations in 7 Topic Areas

1. Leadership

1. Establish proponency for systems modeling use across the acquisition lifecycle
2. Expand view of systems modeling to include physical modeling techniques

2. Reference Models

1. Develop current and future state reference models
2. Manage appropriate changes to policy and guidance related to systems modeling use in acquisition
3. Gather evidence and build guidance for incorporation of modeling use early in the program lifecycle

3. Data Management

1. Assess current standards in metadata capture, and develop standards where gaps exist
2. Assess data warehousing approaches and develop appropriate implementation requirements and plans
3. Improve access to BLUFOR data
4. Collect and use environmental data

AMSS
Recommendations in 7 Topic Areas

4. Making Model Based Systems Viable and Affordable

1. Assess current costs (resources and schedule) associated with use of modeling; identify reduction activities
2. Establish priorities for improving quality and effectiveness of systems modeling use in acquisition

5. Improving Human Behavior Representation and Other Orphaned Technologies

1. Improve Human-Interpretable Modeling
2. Identify next-generation simulation design, and design techniques
3. Assess and improve federation construction tools
4. Improve understanding of results from model-based analysis
5. Explore alternate modeling techniques, and support to conceptual modeling
6. Improve integration with physics-based models
7. Provide enhanced support to test
8. Provide enhance HBR, and interoperation with HBR models
9. Explore ensemble modeling to assist with uncertainty exploration

AMSS
Recommendations in 7 Topic Areas

6. Business Processes

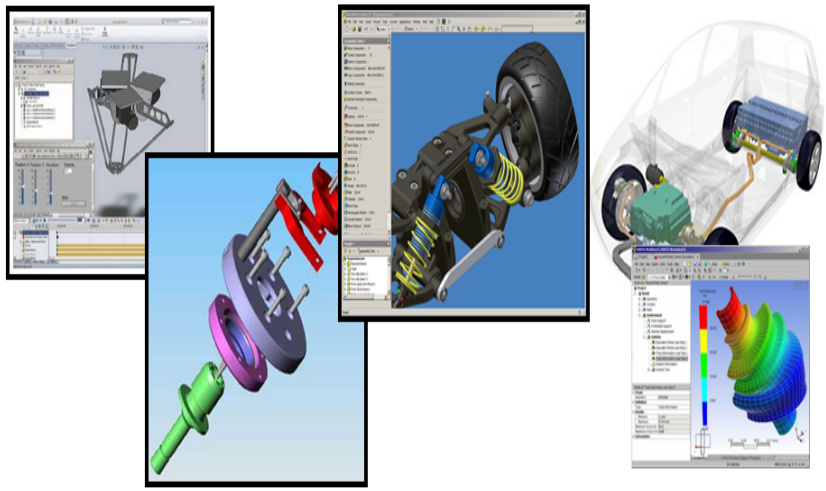
1. Provide method to analyze POM and program planning to anticipate gaps in system modeling use in acquisition
2. Identify rationale to support investment in system modeling use in acquisition
3. Establish a technology working group focused on system modeling use in acquisition
4. Establish best practices and guidance, and revise as system modeling use in acquisition advances
5. Develop boilerplate (RFP, CDRL, SOW….) language for ensuring adequate systems modeling across the acquisition program lifecycle
6. Use system modeling results in the RFP and RFP response process
7. Develop practitioners skilled in system modeling use in acquisition.

7. Measuring Progress

1. Identify metrics and methods for measuring progress of adoption and use of system modeling in acquisition activities
2. Accurately identify model capabilities used in system modeling use in acquisition, and measure progress.

Systems Modeling Use in Acquisition
A 10,000 Ft View of the Practice

- The use of models and the insights gained from their use, aid in the conceptualization, resource estimation, design, deployment and sustainment of systems
- It is not limited to engineering; it enables engineering rigor across all acquisition functions
- The tools and processes for systems modeling and use are not separate functions; they enable acquisition functions to be more efficient
- "Modeling" refers to a wide range of artifacts, to include physical and computer based
- Application of models supports reduction of program uncertainties, at any point in time, in cost, schedule, and performance



The concept is still maturing

- In far more use that often recognized
- Has proven to be powerful when used
- Is not perfected, and *requires intelligent use*
- Adoption has been uneven across DoD to date

Model based acquisition does not diminish the importance of simulations; it increases the relevance of simulation output through consistent use of complete models

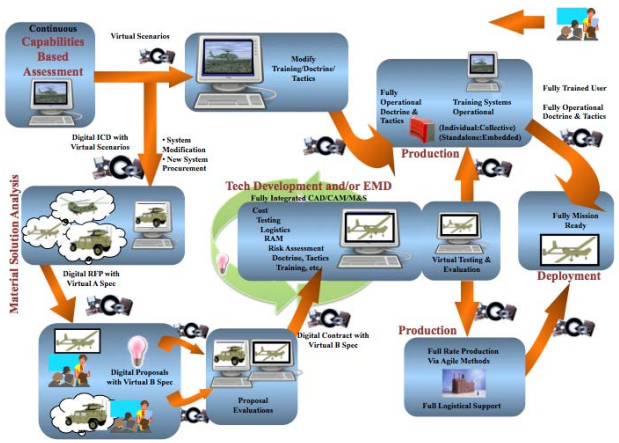
Desired Systems Modeling Use in Acquisition

Capabilities Based Assessment
- Digital ICD format and content, including the associated models, simulations and data
- Similar data for the doctrine/tactics/training community

Materiel Solution Analysis
- Contracting language
- Intellectual property (IP) management
- Model validation adequate to manage contract
- PM guidelines for standing up a model based program

Tech Development/EDM
- Authoritative system design model definition, including manufacturing data
- Integrated processes across program elements
- Adequate engineering quality models and processes

Production
- Full linkage from ASDM to logistics support docs
- Linkage from TD/EDM modeling to training systems



Deployment
- Ability to field support documentation simultaneous with end product

Testing
- Automated test planning linked to system evolution

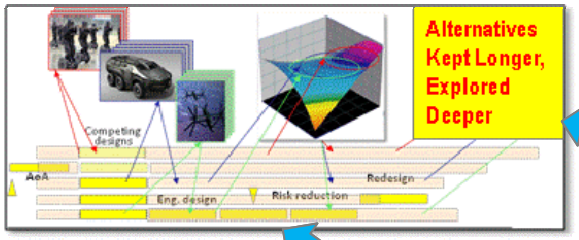
Across the Board
- Singular ASDM, current with design, usable in all acquisition lifecycle activities.
- Provides ability to keep the End User engaged and providing valuable input across the development life cycle
- Provides ability to manage data across the life cycle, with current SE practices
- Provides for integrated cost and scheduling activities and analysis
- Full application of MBSE/MBE practices

… and necessary to support Engineered Resilient Systems

As a Basis for the Future – Engineered Resilient Systems

Systems Representation and Modeling

– Physical, logical structure, behavior, interactions, interoperability…



Characterizing Changing Operational Contexts

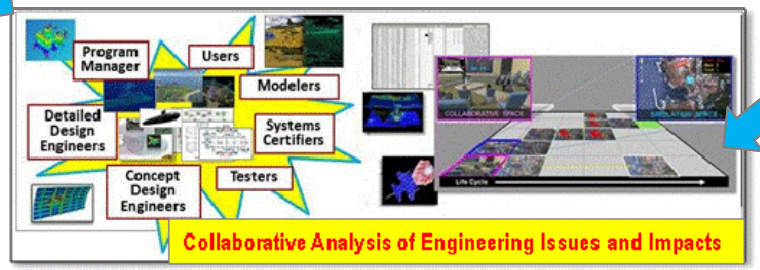
– Deep understanding of warfighter needs, impacts of alternative designs

Cross-Domain Coupling

– Model interchange & composition across scales, disciplines

Data-driven Tradespace Exploration and Analysis

– Multi-dimensional generation/evaluation of alternative designs



Collaborative Design and Decision Support

– Enabling well-informed, low-overhead discussion, analysis, and assessment among engineers and decision-makers

Summary

- **The AMSS and AMSS Implementation Plan encourage common solutions, through implementation experiences**
  - converge towards improved use of systems modeling use across all acquisition activities
- **Systems modeling use in acquisition is a practice for changing, identifying and delivering key enablers that will support the Services' and Agencies' development of capabilities**
  - Evidence based guidance and support to programs of record
  - Identify and incorporate best practices in application of mod/sim
  - Implementation challenges are not limited to the tools
- **Service and agency participation in support body (AMSWG) will enable consistent understanding and execution of systems modeling use in acquistion.**
  - HOWEVER, it's up to the Services and Agencies in support of their program managers to determine the best implementation for their acquisition programs

Questions?

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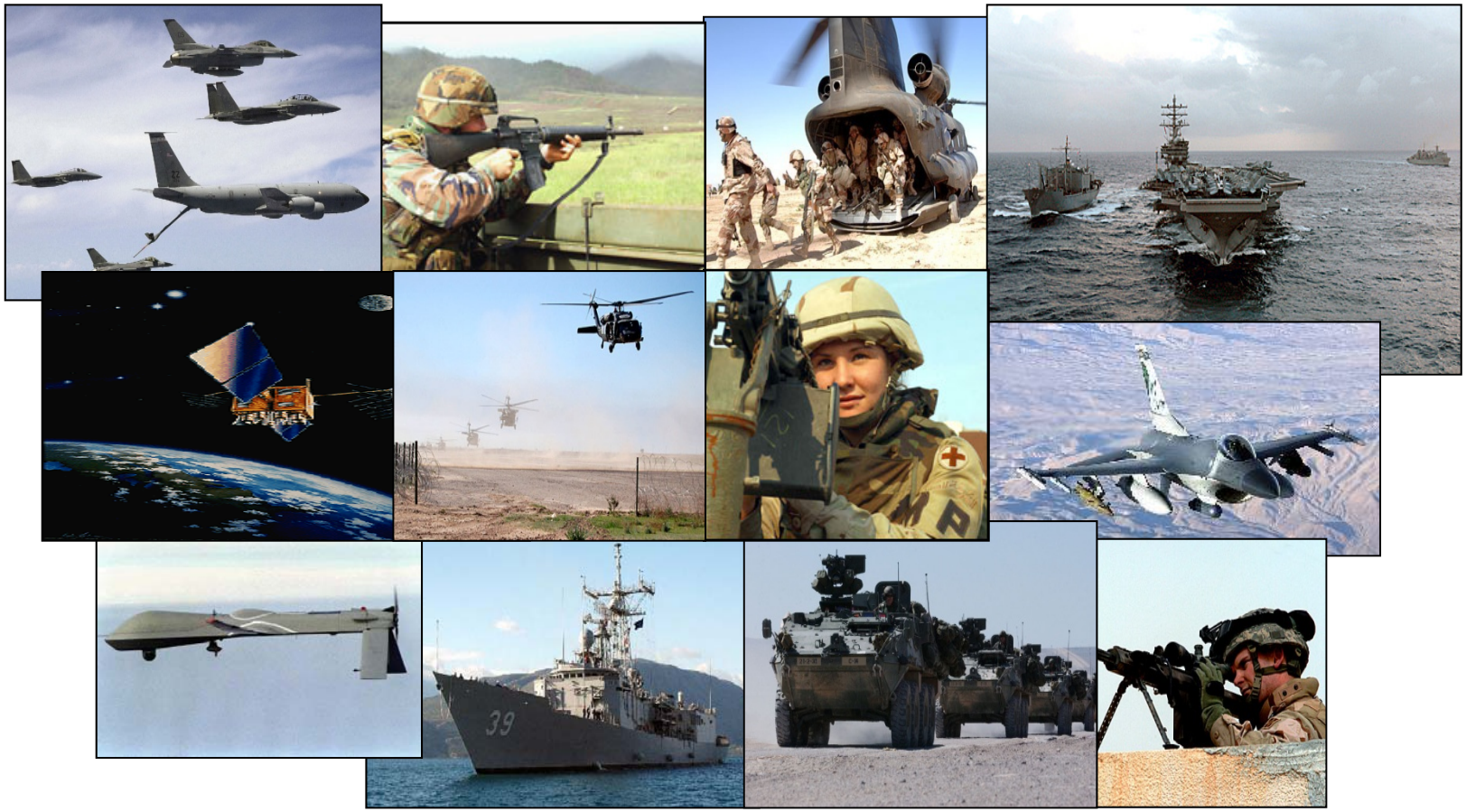
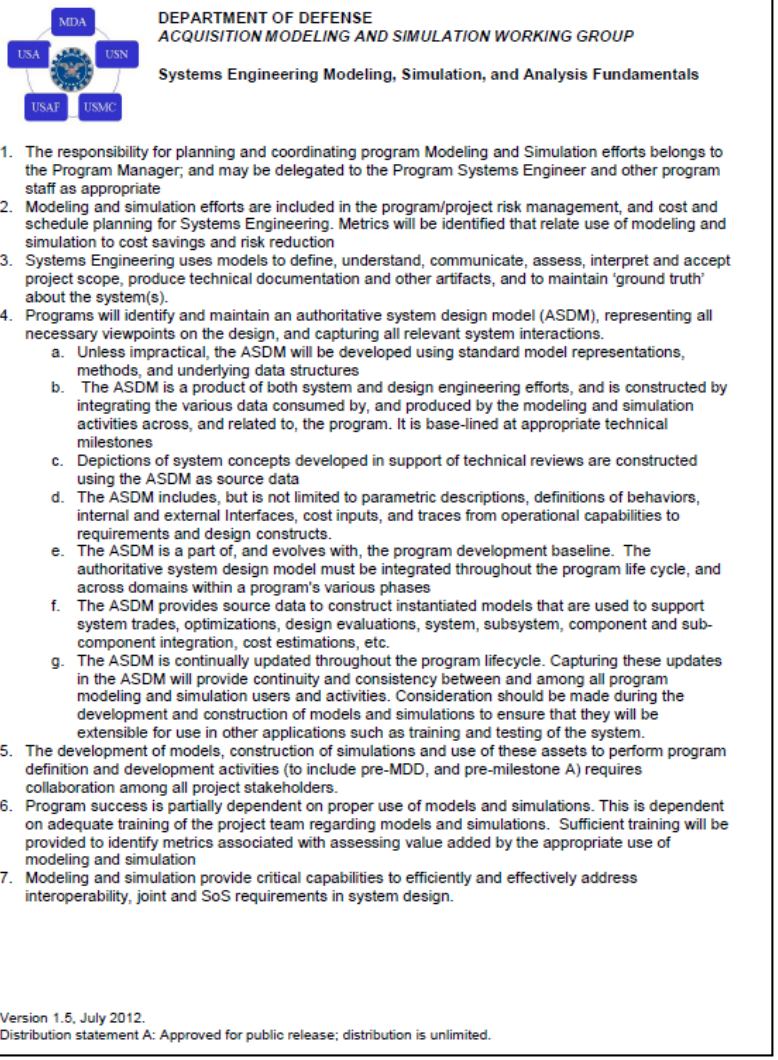
Systems Engineering: Critical to Program Success



Innovation, Speed, and Agility

http://www.acq.osd.mil/se

Key Activity: MS&A Fundamentals
AMSS Builds upon the Basics



DEPARTMENT OF DEFENSE
ACQUISITION MODELING AND SIMULATION WORKING GROUP

Systems Engineering Modeling, Simulation, and Analysis Fundamentals

1. The responsibility for planning and coordinating program Modeling and Simulation efforts belongs to the Program Manager; and may be delegated to the Program Systems Engineer and other program staff as appropriate
2. Modeling and simulation efforts are included in the program/project risk management, and cost and schedule planning for Systems Engineering. Metrics will be identified that relate use of modeling and simulation to cost savings and risk reduction
3. Systems Engineering uses models to define, understand, communicate, assess, interpret and accept project scope, produce technical documentation and other artifacts, and to maintain 'ground truth' about the system(s).
4. Programs will identify and maintain an authoritative system design model (ASDM), representing all necessary viewpoints on the design, and capturing all relevant system interactions.
   a. Unless impractical, the ASDM will be developed using standard model representations, methods, and underlying data structures
   b. The ASDM is a product of both system and design engineering efforts, and is constructed by integrating the various data consumed by, and produced by the modeling and simulation activities across, and related to, the program. It is base-lined at appropriate technical milestones
   c. Depictions of system concepts developed in support of technical reviews are constructed using the ASDM as source data
   d. The ASDM includes, but is not limited to parametric descriptions, definitions of behaviors, internal and external Interfaces, cost inputs, and traces from operational capabilities to requirements and design constructs.
   e. The ASDM is a part of, and evolves with, the program development baseline. The authoritative system design model must be integrated throughout the program life cycle, and across domains within a program's various phases
   f. The ASDM provides source data to construct instantiated models that are used to support system trades, optimizations, design evaluations, system, subsystem, component and sub-component integration, cost estimations, etc.
   g. The ASDM is continually updated throughout the program lifecycle. Capturing these updates in the ASDM will provide continuity and consistency between and among all program modeling and simulation users and activities. Consideration should be made during the development and construction of models and simulations to ensure that they will be extensible for use in other applications such as training and testing of the system.
5. The development of models, construction of simulations and use of these assets to perform program definition and development activities (to include pre-MDD, and pre-milestone A) requires collaboration among all project stakeholders.
6. Program success is partially dependent on proper use of models and simulations. This is dependent on adequate training of the project team regarding models and simulations. Sufficient training will be provided to identify metrics associated with assessing value added by the appropriate use of modeling and simulation
7. Modeling and simulation provide critical capabilities to efficiently and effectively address interoperability, joint and SoS requirements in system design.

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Distribution statement A: Approved for public release; distribution is unlimited.

http://www.acq.osd.mil/se/docs/SE-MSA-Fundamentals.pdf

- **Purpose:** One page that conveys a high-level, concise, and comprehensive set of truths for Mod/Sim usage in Systems Engineering support to programs
- **Key Areas Emphasized:**
  - Program Systems Engineer is responsible for Mod/Sim planning and coordination
  - Mod/Sim is included in key schedule and programmatic plans
  - SE uses models to define, understand, and communicate technical artifacts
  - Models are continually updated throughout program life-cycle
  - Project success is dependent on appropriate Mod/Sim training of team

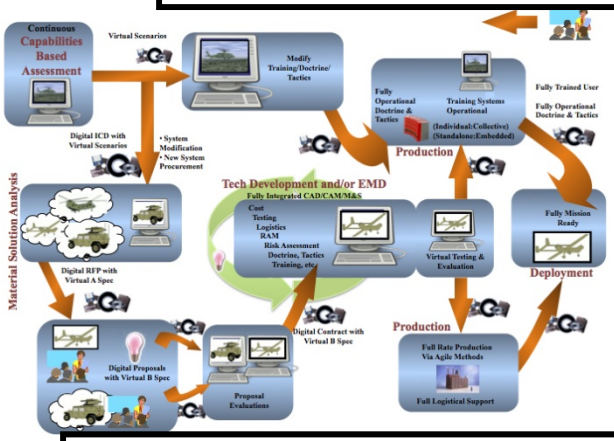
Model Based System Acquisition High Level View

Capabilities Based Assessment
•Digital ICD format and content, including the associated models, simulations and data
• Similar data for the doctrine/tactics/training community

Material Solution Analysis
• Contracting language
• IP management
• Model validation adequate to manage contract
• PM guidelines for standing up a MBSA based program

Testing
• Life cycle V&V for testing support

Production
• Full linkage from ASDM to logistics support docs
• Linkage from TD/EDM modeling to training systems



Deployment
• Ability to field support documentation simultaneous with end product

Tech Development/EDM
• Authoritative System Design Model (ASDM) definition, including manufacturing data
• Integrated processes across program elements
• Adequate engineering quality models & processes

Across the Board
•Effective methods to keep the End User engaged and providing valuable input across the development life cycle
• Methods to manage data across the life cycle
• Efficient (cost/schedule) methods to develop necessary models & simulations
• New and better model based engineering practices

Missing Today: Identified Leadership to Set A Common Vision and Direction

MBSE, MBE, … and MBSA

- **MBSE (INCOSE):** Model-based systems engineering (MBSE) is the formalized application of modeling to support system requirements, design, analysis, verification and validation, beginning in the conceptual design phase and continuing throughout development and later life cycle phases.
- **MBE (NDIA):** MBE, ….is an approach to engineering in which models: are an integral part of the technical baseline; evolve throughout the acquisition life cycle; are integrated across all program disciplines (e.g., systems engineering, operations analysis, software engineering, hardware engineering, manufacturing, logistics, etc.);and can be shared and/or reused across acquisition programs, including between Government and Industry stakeholders**.**

MBSA: a way to infuse the MBSE/MBE approach across all phases and activities of the defense acquisition life cycle. ODASD(SE) is approaching this through use of an Authoritative System Design Model (ASDM).

This perspective represents a major shift from the current practice, which tends to result in multiple instantiations of the system concept created and maintained by different functional disciplines involved in the program.

MBSA: Haven't I Heard this Before?

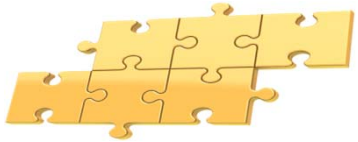
- **DoD M&S Master Plan (1995)** – Objective 3: Provide authoritative representations of systems. Systems include US, Allied, coalition and threat major platforms, weapons, sensors, units, life-support systems, C4I systems, and logistics support systems. Authoritative representations of systems require models of the systems and their associated parameters…..
- **SBA TF (1998)** – SBA: an acquisition process in which DOD and industry are enabled by robust, collaborative use of simulation technology that it integrated across acquisition phases and programs
- **SBA, from DSMC (1998)** – the goals of SBA are to: Substantially reduce the time, resources, and risk associated with the enterprise acquisition process; Increase the quality, military worth, an supportability of fielded systems, while reducing total ownership costs throughout the total lifecycle; and to enable Integrated Product and Process Development across the entire acquisition lifecycle
- **Digital Product Description (DPD – 2011) from Wikipedia** - is the practice of using 3D digital data (such as solid models and associated metadata) within 3D CAD software to provide specifications for individual components and product assemblies. The types of information included are geometric dimensioning and tolerancing (GD&T), component level materials, assembly level bills of materials, engineering configurations, design intent, etc. By contrast, other methodologies have historically required accompanying use of 2D drawings to provide such details.

MBSA represents a subtle shift away from simulation by emphasizing the importance of a central model, without diminishing the importance of simulation

How Do We Make It Real?

- **Guide: Build experience-based guidance and take advantage of OSD(AT&L) activities (e.g DAG update)**
- **Build: Reuse definitional work that has already been done for other purposes, both within DoD and elsewhere. We need to discover, identify, and most of all, not disturb the ongoing efforts; rather take advantage of their results…**
- **Apply: Prototype the system content, and system viewpoints, and the relationships between the elements of the viewpoints, and encapsulate them in the Authoritative System Design Model.**
- **Cost: Do not burden the Programs of Record with development of the concept; rather use their needs to drive the direction; provide "Starter Kit" capabilities and training**






Acquisition Modeling & Simulation Document Relationships